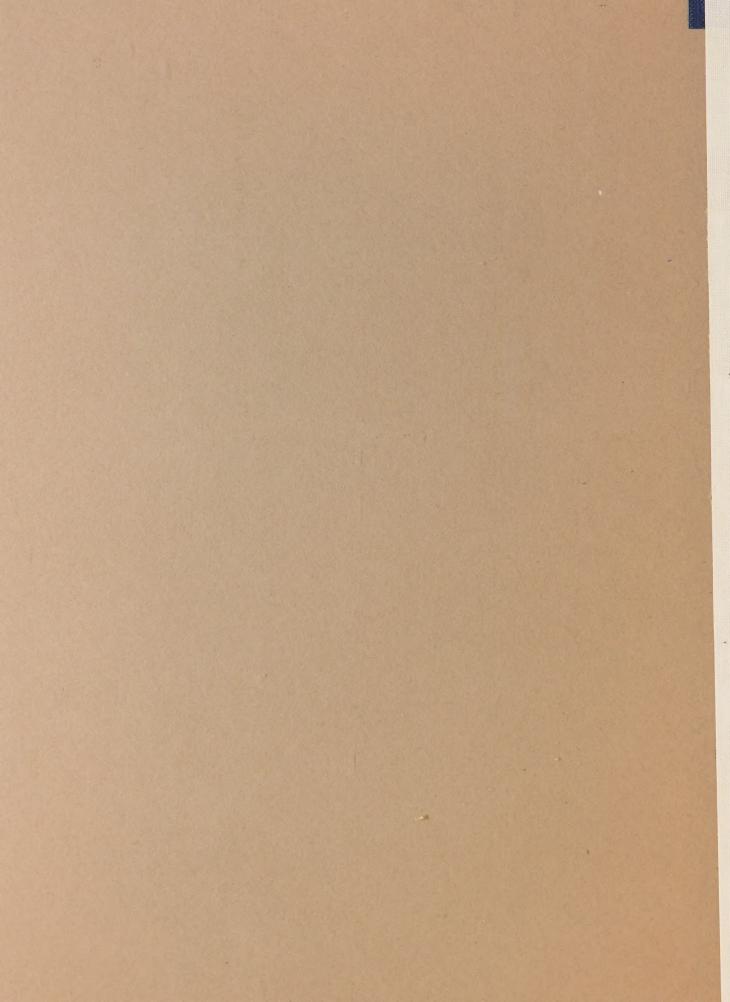
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Trade analyses series An analysis of industrial insulation application and installation. 1967.



#### AN ANALYSIS

OF

# INDUSTRIAL INSULATION APPLICATION AND

INSTALLATION

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PREPARED BY

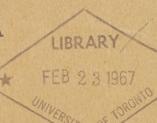
A NATIONAL COMMITTEE

APPOINTED BY

THE DEPARTMENT OF MANPOWER
AND IMMIGRATION

OTTAWA, CANADA

1967





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## INDUSTRIAL INSULATION APPLICATION

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  - INDUSTRIAL INSULATION APPLICATION AND INSTALLATION •



#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

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ROGER DUHAMEL, F.R.S.C. Queen's Printer and Controller of Stationery Ottawa, Canada 1967

#### - INTRODUCTION -

#### HISTORY AND ORGANIZATION

The first National Conference on Apprenticeship and Industries held in Ottawa in May 1952, recommended that the federal government be requested to co-operate with Provincial Apprenticeship Committees and those concerned with Apprenticeship Training in preparing Trade analyses of a number of skilled occupations.

Late in 1965 an Ad Hoc Committee was appointed by the federal Department of Labour to advise the Industrial Training Committee of the National Technical and Vocational Training Advisory Council on the skilled manpower requirements and training needs of the construction industry. Prior to this the Technical and Vocational Training Branch of the federal Department of Labour at the request of the Canadian Construction Association, undertook a functional analysis of the construction industry. As a result of the functional analysis study, the Ad Hoc Committee was able to recommend that a number of occupational analyses be undertaken. In view of the foregoing a committee of three experts nominated from a broad cross-section of the industry were appointed to analyse Industrial Insulation Application and Installation. This committee, selected and co-ordinated by Mr. Joseph Watts, Applied Insulation Co. Ltd., consisted of the following members:

Mr. T. Hopkinson, Johns Manville Co. Ltd.

Mr. H.L. McBrien, H. McBrien Pipe & Boiler Insulation Co.

Mr. Joseph Watts, Applied Insulation Co. Ltd.

This committee was convened by Mr. G.L. Bratt, Training Consultant (Curriculum), Technical and Vocational Training Branch, Ottawa.

#### NATURE AND SCOPE OF THE ANALYSIS

The scope of this analysis deals primarily with thermal insulation that is confined specifically to the installation and

application of insulants to supply piping, process piping, vessels and equipment found in industrial, commercial, institutional and in some cases residential establishments. While there are other requirements for insulation in the construction industry, such as acoustic materials installation and acoustic tile application and the control of heat gain and heat loss through the installation of exterior wall insulants, which have traditionally been considered to be the responsibility of other occupations, this analysis does cover those highly specialized aspects of the application of wall and acoustical insulants in industrial and commercial construction.

Prior to World War II, any control of thermal conductivity through the application and installation of insulation was generally carried out by the workmen who installed the piping vessels and equipment. Lacking the variety of specialized materials and techniques available today, together with a limited knowledge in the significane of insulation, thermal conductance was controlled through the application of such materials as rags, paper or admixtures of asbestos cements. The only other alternative was no insulation at all. Testimony of these techniques is evident today in the demolition of many of the older commercial and industrial establishments.

With the advance of technology and the development of highly sophisticated industrial and commercial techniques and processes, the control of thermal conductivity, together with environmental and ambient conditions, become an essential factor in these industrial and commercial operations. These changes have resulted in a demand by the construction industry for more advanced insulating techniques and better trained and more knowledgeable insulation mechanics.

In setting forth the requirements of this occupation, the committee recognizes that through the drama of change associated with this era of technological developments, more formal training is an absolute prerequisite in industrial insulation application and installation. If the continuing demand for this work in the construction industry is to be met, this training should provide the means for developing those abilities which are not as yet general throughout the industry. These are; skill in prefabrication techniques, a more intimate knowledge of the application and utilization of an ever increasing variety of insulants and environmental conditions in which they are applied, and a basic understanding of the principles of estimating and job organization.

Although the committee has outlined the entire requirements for technical competency in this occupation, there are certain intangible attributes that make the difference between an ordinary and outstanding workman. These are, cleanliness, adaptability to complex situations and ability in continuing study to keep abreast of new developments in the utilization of materials and their application in an ever changing scene. Safety, as such, is not mentioned in the analysis, but implied in the identification of good work practices and in the identification of particular hazards and conditions in performing a particular function.

#### PROCEDURE

Each committee member elected to prepare certain sections of the overall task, and subsequently reviewed and criticized each other's work as a group prior to final preparation. It was hoped that this procedure would insure the validity of the completed project.

Furthermore, to insure that the final result would be acceptable throughout Canada, draft copies were distributed widely to industry and Provincial Vocational Education Authorities for critical comment. Suggestions emanating from these sources were reviewed and any valid changes incorporated into the text.

#### PURPOSE AND USE OF THE ANALYSIS

It should be emphasized that this not a course of study and it is not intended that operations be mastered in the sequence shown. The Analysis is recommended as the basis of instruction in industry, trade schools and institutes, as a guide to foremen for on-the-job training, and as a basis for evaluating previous experience.

Officials of the Technical and Vocational Training Branch, Ottawa, wish to express their sincere appreciation for the contributions of the Committee participants and their Companies, and for the co-operation, interest and help of the Provincial Directors of Apprenticeship and Vocational Education.



## AN ANALYSIS OF INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

	BLOCK 1: Tools and Procedures
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UNIT 1:	Hand Tools page 2
2:	Power Tools and Shop Equipment

BLOCK 1	:	Tools and	Procedures	UNIT 1 :	Hand Tools
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FUNCTIONS	KNOWLEDGE
1. Selecting and cutting with saws	<ul> <li>(a) Type, use and features of saws:</li> <li>(i) keyhole</li> <li>(ii) pruning</li> <li>(iii) hand</li> <li>(iv) metal cutting</li> </ul>
	(b) Characteristics, size and type of saws and saw blades:  (i) number of teeth  (ii) cutting characteristics and speed  (iii) size
	(c) Features and characteristics of materials to be cut:     (i) asbestos     (ii) glass - foam and fibre     (iii) plastics     (iv) cork     (v) ferrous and non-ferrous metals     (vi) others
	(d) Factors to be considered in the selection of saws and saw blades when cutting various materials: (i) speed (ii) pressure (iii) number of teeth (iv) cutting characteristics of material (v) clearance (kerf)
	(e) Techniques of sawing (f) Procedures for starting cuts (g) Effects of binding (h) Importance of and procedures for supporting material being cut
	(i) Methods of sharpening and setting saws (j) Care and storage of saws (k) Science: (i) physical properties of ferrous and non-ferrous metals (ii) plastics - thermosetting and thermoplastic (iii) source properties and uses of: (a) asbestos (b) glass (foam and fibre) (c) cork

BLC	OCK 1: Tools and Procedures	UNIT 1 : Hand Tools
	FUNCTIONS	KNOWLEDGE
2.	Selecting and using pliers	<ul> <li>(a) Type, purpose, size and use of pliers: <ul> <li>(i) side, end and diagonal cutters</li> <li>(ii) combination</li> <li>(iii) staple</li> </ul> </li> <li>(b) Considerations in the selection of type, size and use of pliers</li> <li>(c) Methods of holding and using pliers for: <ul> <li>(i) twisting</li> <li>(ii) cutting</li> <li>(iii) pulling</li> <li>(iv) pressing</li> <li>(v) stapling</li> <li>(vi) holding or clamping</li> </ul> </li> <li>(d) Techniques for pulling and twisting wire to prevent overstressing</li> <li>(e) Importance of properly finishing ends of wire attachments after twisting and pulling</li> <li>(f) Hazards relating to the handling, pulling and twisting of wire</li> <li>(g) Care and storage of pliers</li> <li>(h) Science: <ul> <li>(i) physical properties of ferrous and non-ferrous metals</li> </ul> </li> </ul>
	Selecting and using wrenches	<ul> <li>(a) Type, size and uses of wrenches: <ul> <li>(i) socket wrenches</li> <li>(ii) open end wrenches</li> <li>(iii) box end wrenches</li> <li>(iv) adjustable wrenches</li> <li>(v) socket-screw wrenches (hexagonal, square and splined)</li> </ul> </li> <li>(b) Type, purpose and use of attachments for socket wrenches</li> <li>(c) Leverage of wrenches</li> <li>(d) Methods of holding and using wrenches</li> <li>(e) Importance of correct fit of wrenches on head of bolt or nut</li> <li>(f) Effects of using incorrect size of wrenches</li> <li>(g) Care, maintenance and storage of wrenches</li> </ul>
		and attachments  (h) Science:  (i) mechanical advantages of simple machines  (ii) principle of levers

BLOCK 1 : Tools and Procedures		UNIT 1 : Hand Tools		
	FUNCTIONS		KNOWLEDGE	
4.	Cutting with hand shears and scissors	(a)	Type, purpose and use of hand shears:  (i) straight  (ii) combination  (iii) circular  (iv) double cut	
		(b) (c)	Type, purpose and use of scissors Types and characteristics of materials to be cut with hand shears and scissors: (i) sheet metal (ii) fabrics (iii) asbestos sheet (iv) other insulants	
		(d)	Considerations in the selection of hand shears and scissors in relation to type	
		(e)	of materials and job Techniques when cutting with hand shears	
		(f)		
		(g)	and scissors Importance of clean cut	
		(h) (i)	<pre>Importance of proper handling of materials: (i) physical protection</pre>	
		(j)		
		(k)	scissors Care and storage of shears and scissors	
		(1)	Science: (i) physical properties of materials	
		(a)	Type, characteristics and uses of trowels:  (i) flat  (ii) gauging  (iii) pointing  (iv) flexible	
		(b)	Features and characteristics of materials to be trowelled:  (i) insulating cements  (ii) finishing cements	
		(c)	<pre>(iii) others Consideration in the selection of trowels: (i) size and type (ii) material to be trowelled (iii) type and size of job</pre>	

#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

	FUNCTIONS		KNOWLEDGE
5.	Selecting and using trowels (cont'd)	(d) (e) (f) (g) (h)	Techniques of trowelling Methods of holding and using trowels Importance of proper material consistency for trowelling Care and storage of trowels Science: (i) sources, properties and uses of:
6.	Selecting and using brushes and rollers	(a) (b) (c) (d)	rollers:  (i) paste brush  (ii) paint brush  (iii) roller  Considerations of size and type of bristle in the selection of brushes for specific purposes  Application and uses of brushes and rollers for:  (i) adhesives  (ii) paints  (iii) mastics  (iv) fire retardant sealers and finishers  (v) others
7.	Rivetting with rivet guns	(a) (b) (c) (d) (e)	rivetting guns Type, size, purpose and application of insulating rivetting pins Methods of rivetting, using: (i) hand-operated guns (ii) snaps and dollies (iii) hammers Importance of properly setting rivets to obtain grip

rivetting

	FUNCTIONS	KNOWLEDGE		
7.	Rivetting with rivet guns	(f)	Effect of inadequate back-up when heading up rivets	
	(cont *d).	(g) (h)	Recognition of incorrectly set rivets Care and storage of rivetting guns and accessories	
8.	Drilling with hand drills and braces	(a)	Type, purpose and use of hand drills and braces	
	and braces	(b)		
		(c)		
		(d) (e) (f) (g)	Methods of sharpening drills and spur bits Procedures for drilling and boring	
		(h) (i)	Care and storage of drills Mathematics: (i) linear measurement to determine location of holes (ii) conversion of fractional and	
		(j)	decimal equivalents Science: (i) heat treatment of ferrous metals (tempering) (ii) abrasives	
9.	Using Knives	(a) (b)	Features and characteristics of material to be cut with knives:  (i) asbestos  (ii) glass - fibre and foam  (iii) plastics  (iv) cork	
		(c) (d)	Importance of support for materials to be cut	
		(e)	Methods of routing and cutting holes with knives	

BLOCK 1 : Tools and Procedures	UNIT 1 : Hand Tools		
FUNCTIONS	KNOWLEDGE		
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10. Selecting and using screwdrivers	(a) Type, features and uses of screwdrivers:  (i) standard  (ii) Robertson  (iii) Phillips  (iv) others		
	(b) Type, size and characteristics of screws:     (i) wood     (ii) self-tapping     (iii) machine     (iv) others		
	(c) Types and features of screw heads (d) Consideration in the selection of types of screwdrivers: (i) standard drive (ii) ratchet drive (iii) combination drive-ratchet and helical (iv) others		
	(e) Methods of using screwdrivers (f) Importance of using correct size of screwdriver		
	(g) Methods of shaping and tempering screwdrivers		
	(h) Care, storage and handling of screw-drivers		
ll. Selecting and using chisels for wood and metal	<ul><li>(a) Type, purpose and use of metal-cutting chisels for:</li><li>(i) shearing</li><li>(ii) splitting</li></ul>		
	(b) Type, purpose and use of wood chisels: (i) flat (ii) gouging		
	(c) Considerations in the selection of correct chisel for proposed operation		
	(d) Methods of holding chisels		

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	FUNCTIONS	KNOWLEDGE	
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12.	Selecting and using files	<ul> <li>(a) Purpose of filing</li> <li>(b) File terminology</li> <li>(c) Use of file manufacturers catalogues in the selection and use of files</li> <li>(d) Type, purpose and use of files: <ul> <li>(i) rasp</li> <li>(ii) bastard</li> <li>(iii) saw file</li> <li>(iv) rat tail</li> <li>(v) other</li> </ul> </li> <li>(e) Factors governing use of files: <ul> <li>(i) size and material of work</li> <li>(ii) shape to be filed</li> <li>(iii) finish required</li> </ul> </li> <li>(f) Types of files for efficient cutting of:</li> </ul>	
		(i) metal (ii) plastics (iii) fibrous materials (iv) others (g) Methods of holding files (h) Procedures for holding work (i) Filing procedures: (i) pressure required (ii) pressure relief on return stroke (iii) optimum speed of stroke (j) Methods of filing flat surfaces (k) Techniques of filing: (i) profiles (ii) to a line	

BLOCK 1 :	Tools and Procedures	UNIT 1 :	Hand Tools
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	FUNCTIONS	KNOWLEDGE
12.	Selecting and using files (cont'd)	<ul><li>(1) Methods of cleaning files</li><li>(m) Type and size of file handles</li><li>(n) Care and storage of files</li></ul>
13.	Selecting and using needles	<ul> <li>(a) Type, purpose and use of needles: <ul> <li>(i) straight</li> <li>(ii) off-set</li> <li>(iii) semi-circular</li> <li>(iv) others</li> </ul> </li> <li>(b) Type, features and characteristics of fabrics to be sewn</li> <li>(c) Type, grade, application and use of thread: <ul> <li>(i) glass</li> <li>(ii) asbestos</li> <li>(iii) linen</li> <li>(iv) cotton</li> <li>(v) wire</li> </ul> </li> <li>(d) Considerations in the selection and application of needles: <ul> <li>(i) type of stitch</li> <li>(ii) number of stiches</li> <li>(iii) material to be sewn</li> </ul> </li> <li>(e) Techniques for sewing fabrics using needles</li> <li>(f) Type, characteristics and use of sewing palms for heavier fabrics</li> <li>(g) Procedures for starting to sew</li> </ul>
		<ul><li>(h) Effects of pulling thread when sewing</li><li>(i) Importance of care when using needles</li></ul>
14.	Selecting and using hammers	<ul><li>(a) Types, use and features of hammers:</li><li>(i) claw</li><li>(ii) ball peen</li></ul>
		(iii) other (b) Considerations in the selection of hammers: (i) size (ii) weight (iii) other
		(c) Importance of proper finish of hammer face (d) Methods of holding and striking with
		hammers (e) Results of choking the hammer

rUNCTIONS			KNOWLEDGE		
14.	Selecting and using hammers (cont d)	(f) (g) (h) (i) (j)	Procedures when peening and rivetting Importance of proper handling of hammer Procedures for installing and/or tightening head on shaft Importance of eye protection Care and storage of hammers		
15.	Selecting and using banding and crimping tools	(a) (b) (c) (d) (e) (g) (h) (i)	Characteristics, application and use of bands and seals Consideration of type and size of bands and seals in the selection of banding and crimping tools Techniques for installing bands and seals Hazards relating to over-tension or breakage of bands during installation Care and storage of banding and crimping tools Mathematics: (i) linear measurement to calculate length and spacing of bands (ii) weights and measures to calculate weights of materials to be supported Science:		
			<ul> <li>(i) mechanical advantage of simple machines</li> <li>(ii) levers</li> <li>(iii) stresses - tensile, compressive and shear</li> <li>(iv) physical properties of materials</li> </ul>		
16.	Measuring with a rule	(a)	Interpretation of drawings and specification to determine:  (i) dimensions  (ii) location  (iii) work or equipment characteristics		

FUNCTIONS	KNOWLEDGE		
16. Measuring with a rule (cont'd)	<ul> <li>(b) Type, use and features of rules: <ul> <li>(i) flexible</li> <li>(ii) spring-tempered</li> <li>(iii) tape</li> <li>(iv) folding</li> </ul> </li> <li>(c) Types of rule and calibrations</li> <li>(d) Accuracy obtainable</li> <li>(e) Procedures for measuring with rules and tapes</li> <li>(f) Methods of holding tapes for single-handed measurements</li> <li>(g) Techniques of measuring: <ul> <li>(i) in confined spaces</li> <li>(ii) complicated shapes</li> </ul> </li> <li>(h) Effect of sag on unsupported tapes</li> <li>(i) Care and storage of rules and tapes</li> <li>(j) Mathematics: <ul> <li>(i) linear measurement for layout</li> </ul> </li> </ul>		
17. Measuring with a scale	<ul> <li>(ii) conversion of fractional and decimal values</li> <li>(a) Interpretation of drawings and specifications to determine: <ul> <li>(i) structural layout and dimensions</li> <li>(ii) insulation layout and shape characteristics</li> <li>(iii) scale of drawing</li> </ul> </li> <li>(b) Types of scales:</li> </ul>		
	<ul> <li>(i) architect's</li> <li>(ii) engineer's</li> <li>(c) Scale calibrations and methods of reading scales</li> <li>(d) Methods of obtaining a correct measurement with scales</li> <li>(e) Limitations on accuracy when scaling drawings</li> <li>(f) Care and storage of scales</li> <li>(g) Mathematics: <ul> <li>(i) linear measurement to determine size</li> <li>(ii) fractional measurement</li> <li>(iii) decimal measurement</li> </ul> </li> </ul>		

BLOCK 1 : Tools and Procedures				
	FUNCTIONS	KNOWLEDGE		
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20.	Using scribers and prick punches	<ul> <li>(a) Type, purpose and use of prick punches and scribers</li> <li>(b) Application and use of: <ul> <li>(i) scribers</li> <li>(ii) prick punches</li> </ul> </li> <li>(c) Techniques of scribing and prick-punching</li> <li>(d) Methods of sharpening and tempering scribers and prick punches</li> <li>(e) Care and storage of scribers and punches</li> <li>(f) Science: <ul> <li>(i) heat treatment of steel</li> <li>(tempering)</li> </ul> </li> </ul>		

BLOCK 1 : Tools and Procedu	res UNIT 1 : Hand Tools
FUNCTIONS	KNOWLEDGE
21. Levelling	<ul> <li>(a) Type, purpose and characteristics of hand levelling instruments and devices: <ul> <li>(i) spirit</li> <li>(ii) plumb-bob</li> <li>(iii) chalk line</li> <li>(iv) water level</li> <li>(v) straight edge</li> </ul> </li> <li>(b) Procedures for levelling</li> <li>(c) Techniques in the application and use of: <ul> <li>(i) plumb-bob</li> <li>(ii) chalk line</li> <li>(iii) water level</li> <li>(iv) straight edge</li> </ul> </li> <li>(d) Importance of care and storage of levels</li> </ul>
22. Using carpenter's forming square	<ul> <li>(a) Type, use and features of forming squares</li> <li>(b) Characteristics of square calibrations</li> <li>(c) Procedures for using square and interpretation of square calibrations</li> <li>(d) Methods of holding forming square when: <ul> <li>(i) laying out</li> <li>(ii) squaring</li> </ul> </li> <li>(e) Care and storage of forming squares</li> <li>(f) Mathematics: <ul> <li>(i) linear and angular measurement for layout</li> <li>(ii) Pythagorean Theorem</li> <li>(3-4-5 rule)</li> </ul> </li> </ul>

BLOC	K l	: Tools	and	Procedures
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1. Cutting metals with power-operated saws		KNOWLEDGE
		Type, purpose and function of power- operated saws:  (i) band  (ii) circular-table -portable
	(b) (c)	Application and use of power-operated saws
	(d)	Application and use of attachments used with various types of power-operated saws: (i) mitering attachments
	(e)	
	(f)	during sawing operations Limitations of portable power saws
	(g)	
	(h) (i)	Methods of removing and installing blades
	(j)	
	(k)	Application and use of jigs and fixtures
	(1)	used with power-operated saws Mathematics:
	` '	<ul><li>(i) angular and linear measurement for setting saws for depth of cut</li><li>(ii) angular and linear measurement for</li></ul>
		setting saws for various other type of cuts
2. Cutting sheet metals with power and foot-operated shears	(a)	Type, purpose and function of shears:  (i) foot-operated squaring shears  (ii) hand-operated, power-actuated slitting shears
	(b)	Thickness capacities of machines for
	(c)	shearing and slitting Procedures for operating and adjustment of
	(0)	shears
	(d)	Methods of setting and adjusting stops on foot-operated squaring shears

FUNCTIONS	KNOWLEDGE		
2. Cutting sheet metals with power and foot-operated shears (cont*d)	(e) Procedures for supporting work when shearing and slitting:  (i) long sheets		
	<ul> <li>(ii) coiled stock</li> <li>(f) Application and use of work-holding devices</li> <li>(g) Procedures for cutting to a straight or curved line when using portable power-</li> </ul>		
	operated shears  (h) Importance of care when using power- actuated slitting shears relative to:  (i) power supply  (ii) improper ground  (iii) extension cord		
	(iv) stopping and starting (i) Importance of periodic machine check and		
	lubrication (j) Methods of sharpening cutting blades (k) Importance of cleanliness and use of scrap bins on work site		
	(1) Hazards relating to the handling of materials when slitting and shearing		
	(m) Hazards when wearing gloves during shearing operations		
	(n) Mathematics:     (i) linear measurement for layout     (ii) decimal and fractional equivalents     to calculate material thicknesses		
3. Forming sheet metal finishes	<ul> <li>(a) Type, purpose and function of forming equipment:</li> <li>(i) breaks</li> <li>(ii) forming rolls</li> <li>(iii) lock formers</li> <li>(iv) bench stakes</li> <li>(v) turning and beading machines</li> </ul>		
	(b) Procedures for locating and setting materials before bending and forming		
	(c) Importance of correct sequence when		
	bending and forming (d) Effects of improper alignment on materials (e) Importance of not exceeding guage capacity of machines and equipment		
	(f) Importance of protecting formed edges and seams		

FUNCTIONS			KNOWLEDGE		
3.	Forming sheet metal finishes (cont'd)	(g)	Use, application, care and adjustment of (i) breakers (ii) forming rollers (iii) lock formers (iv) turning and beading machines		
		(h) (i)	Application and use of bench stakes Importance of maintenance and lubrication		
		(j)	of machines and equipment Hazards relating to the handling of sheet metal		
		(k) (l)	Care and storage of machines and equipment Mathematics:  (i) linear measurement for layout  (ii) decimal or fractional values to		
		(m)	calculate bend allowances  Science: (i) mechanical advantage of simple machines (ii) lubricants and their uses (iii) levers		
4.	Welding with portable pin- welding machines	(a)	Principles of joining metals with portable pin-welding machines		
		(c)	Type, purpose and characteristics of portable pin-welding machines		
			Considerations affecting the selection and size of machines for specific uses		
		(e)	pins welded anchors: (i) pins (ii) threaded attachments		
		(f)	(iii) other Importance of availability of adequate power source when using portable pin- welding machines		
		(g) (h)	Techniques for locating pins Limitations of pin-welded connections		

BLOCK 1: Tools and Procedures		UNIT 2 : Power Tools and Shop Equipment		
FUNCTIONS		KNOWLEDGE		
4.	Welding with protable pin- welding machines (cont d)	<ul> <li>(i) Techniques of welding with pin-welding machines</li> <li>(j) Setting of machines to obtain optimum welding conditions</li> <li>(k) Conditions affecting the satisfactory operation of pin-welding machines: <ul> <li>(i) cleanliness and type of contact surface</li> <li>(ii) incorrect temporary setting</li> <li>(iii) Insufficient pre-setting time</li> <li>(iv) improper ground</li> </ul> </li> <li>(1) Care, storage and maintenance of pin-welding machines</li> </ul>		
		<pre>(m) Science:     (i) amperage and voltage resistance     (ii) Ohms Law     (iii) voltage drop and its measurement     (iv) oxidation</pre>		
5.	Drilling holes with portable drills and drill braces	<ul> <li>(a) Interpretation of drawings to determine: <ul> <li>(i) size and accuracy of holes</li> <li>(ii) location of holes</li> </ul> </li> <li>(b) Drilling procedures for various materials: <ul> <li>(i) wood</li> <li>(ii) steel</li> <li>(iii) cast iron</li> <li>(iv) non-ferrous metals</li> <li>(v) concrete</li> <li>(vi) plastic</li> <li>(vii) others</li> </ul> </li> <li>(c) Proper method of holding work: <ul> <li>(i) vises</li> <li>(ii) clamps</li> </ul> </li> <li>(d) Method of starting a hole</li> <li>(e) Procedures and accessories used in drilling holes: <ul> <li>(i) drill guides</li> <li>(ii) steel square</li> <li>(iii) support for drill</li> </ul> </li> </ul>		
		(f) Use of depth stops and bushings to control the depth of holes		

FUNCTIONS			KNOWLEDGE		
5.	Drilling holes with portable drills and drill presses (cont'd)	(g)	Method of increasing pressure for drilling:  (i) levers  (ii) jacks  (iii) magnetic or clamped drill mounting attachments		
		(h)	Use of cutting oils and coolants used with metals		
		(i) (j)	Procedures in drilling overhead holes Hazards relating to: (i) flying cuttings (ii) torque reaction due to binding of drill in hole		
		(k)	Importance of using protective devices		
		(1)	and clothing Importance of grounding while using portable electric drills		
		(m)			
		(n)			
6.	Spraying	(a)	guns and equipment: (i) airless		
		(b)	be sprayed with spray guns:  (i) mastics  (ii) foam insulants  (iii) asbestos  (iv) paint  (v) adhesives  (vi) granular insulants  (vii) others		
		(c)	Techniques of spraying and applying various materials		
		(d)	Techniques of mixing materials for proper		
		(e)	for mixing and spraying:		
			(i) water (ii) electrical (iii) heat		

BLOCK 1 : Tools and Procedures	UNIT 2: Power Tools and Shop Equipment			
FUNCTIONS	KNOWLEDGE			
6. Spraying (cont*d)	(f) Factors governing the use of sprayed materials:  (i) danger of combustion or air contamination  (ii) damage to machines, equipment or facilities  (iii) nature of atmospheric environment  (g) Limitations in the use of spraying equipment  (h) Environmental conditions affecting the application of sprayed materials  (i) Methods and importance of providing protection for equipment and adjacent area  (j) Importance of following relevant manufacturers' specifications, directive and manuals in the application of spraying materials  (k) Care, storage and minor servicing of spraying equipment before and after use  (l) Mathematics:  (i) ratio and proportion to determine mix ingredients  (ii) linear measurement to calculate area and thickness of surface to be sprayed  (m) Science:  (i) composition and properties of materials  (ii) toxic effects of materials  (iii) type, use and action of fire extinguishers  (iv) solvents			

### AN ANALYSIS OF INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

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#### INDUSTRIAL INSULATION AND APPLICATION AND INSTALLATION

BLOCK	2:	Rigging
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#### UNIT 1 : Scaffolds

FUNCTIONS	KNOWLEDGE
1. Erecting platform scaffolds	(a) Types, care and use of platform scaffolds:     (i) single and multiple plank (wood and metal)     (ii) rigid platform     (iii) ladder and plank  (b) Importance of inspection before use (c) Methods of hanging scaffolds using:     (i) single rope support     (ii) needle beams     (iii) rope blocks (d) Methods to prevent sideways movement of hanging scaffolds (e) Procedures for raising, lowering and tying off platform scaffolds (f) Importance of provision of hand rails, safety belts and safety harness (g) Importance of providing adequate plank overhang (h) Need for adherence to safety rules, regulations and applicable codes (i) Science:     (i) strength of materials     (ii) principles of levers
2. Erecting unit-type scaffolds	<ul> <li>(a) Types, care, use and size of standard scaffold units</li> <li>(b) Methods of assembling multiple units</li> <li>(c) Importance of solid footing</li> <li>(d) Need for adherence to safety rules and use of safety devices: <ul> <li>(i) assembly locks</li> <li>(ii) wheel locks</li> <li>(iii) guard rails</li> <li>(iv) braces</li> <li>(v) plank positioning cleats</li> </ul> </li> <li>(e) Importance of levelling</li> <li>(f) Science: <ul> <li>(i) strength of material</li> </ul> </li> </ul>

BLOCK 2: Rigging	UNIT 2 :
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BLOCK 2: Rigging	UNIT 2 : Hoists
FUNCTIONS	KNOWLEDGE
1. Selecting and using hoists	(a) Types, care and use of hand-operated hoists:     (i) rope blocks     (ii) spur gear     (iii) worm gear     (iii) worm gear     (iv) differential gear  (b) Types, use and care of power-operated hoists:     (i) electric     (ii) pneumatic  (c) Hoist load capacity  (d) Use of handhooks to obtain strength of rope, chain, or cables  (e) Results of overloading on:     (i) chain     (ii) pins or keys  (f) Importance of regular maintenance and inspection of hoists  (g) Results of improper operation of hoists:     (i) overloading     (ii) sideways pull     (iii) twisting of ropes and chains  (h) Effects of hoisting with worn or damaged equipment     (i) worn or distorted chain     (ii) frayed, stretched or kinked rope     (iii) insecure splices  (i) Need for engineering advice when using supporting devices  (j) Methods of shoring for additional support  (k) Use of isolated supports, such as:     (i) tripods     (ii) 'A' frames  (l) Importance of proper inspection before using     (m) Techniques for installation of hanging hoists (n) Science:     (i) pulleys and pulley ratios

BLOCK 2: Rigging	UNIT 3 : Ropes and Slings	
FUNCTIONS	KNOWLEDGE	
l. Selecting and installing slings	<pre>(a) Types, care and uses of slings:     (i) rope     (ii) cable (wire rope)     (iii) chain</pre>	
	(b) Types, use and care of attachments:     (i) thimbles     (ii) clamps     (iii) shackles     (iv) spreader bars     (v) equalizer beams	
	<ul> <li>(c) Sling member angles and allowable loads</li> <li>(d) Strength of rope, cable and chain</li> <li>(e) Strength of shackles</li> <li>(f) Use of Canadian Standards Association standards, handbook, manufacturers catalogues and specifications to determine</li> <li>(i) sling strengths</li> </ul>	
	(ii) slinging procedures (g) Techniques for positioning slings for:     (i) balanced loads     (ii) unbalanced loads (h) Importance of protection to equipment (i) Methods of slinging various loads (j) Results of sharp bends and kinks (k) Techniques of joining cable by use of clam (l) Methods of tying knots:     (i) bowline     (ii) reef	
	(iii) half-hitch  (m) Mathematics:     (i) geometry to calculate sling angles     (ii) weights and measures to estimate     loads	
	<ul> <li>(n) Science:</li> <li>(i) centre of gravity</li> <li>(ii) strain - tensile, compressive, shear</li> <li>(iii) stress - tensile, compressive, shear</li> <li>(iv) factor of safety</li> </ul>	
2. Slings and ropes	(a) Importance of regular inspection for:     (i) corrosion     (ii) wear     (iii) kinks     (iv) broken strands     (v) worn or stretched chain links	

BLOCK 2: Rigging	UNIT 3 : Ropes and Slings
FUNCTIONS	KNOWLEDGE
2. Slings and ropes (cont'd)	<ul> <li>(b) Results of dampness</li> <li>(c) Effects of improper storage</li> <li>(d) Hazards of handling without gloves</li> <li>(e) Results of exposure to corrosive materials</li> <li>(f) Science: <ul> <li>(i) corrosion</li> <li>(ii) factor of safety</li> </ul> </li> </ul>

BLOCK 2 : Rigging	UNIT 4 : Ladders
FUNCTIONS	KNOWLEDGE
1. Erecting ladders	(a) Types, care and use of ladders:     (i) straight     (ii) extension     (iii) platform     (iv) step     (v) special type  (b) Importance of use of sound material for ladders and planking  (c) Use of planking with ladders  (d) Importance of care and procedures for use of ladders by:     (i) provision of solid footing     (ii) use of safety feet     (iii) use of securing bolts     (iv) lashing of top  (e) Special techniques when using ladders on slopes  (f) Importance of maintaining proper ladder angle to the vertical  (g) Results of contact between metal ladder and uninsulated electrical conductors  (h) Methods of transporting ladders by hand     (i) horizontal     (ii) vertical  (i) Methods used to erect ladders from a horizontal position:     (i) straight     (ii) extension
	(j) Importance of securing ladder

# AN ANALYSIS OF INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

	BLOCK 3: Insulation Preparation	
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2:	Fabrication Techniques	30

#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

# BLOCK 3: Insulation Preparation UNIT 1: Layout Techniques

FUNCTIONS	KNOWLEDGE
1. Laying-out shop work	<ul> <li>(a) Interpretation of drawings and specifications to determine:</li> <li>(i) characteristics of surfaces to be insulated</li> <li>(ii) location</li> <li>(iii) area of surface</li> </ul>
	<pre>(iv) type of insulation (b) Geometrical principles of laying-out</pre>
	(c) Factors to be considered when laying-out insulation for specific surfaces:  (i) location  (ii) type of insulation  (iii) type and location of anchors and and attachments  (iv) optimum utilization of size and position of insulation material  (v) types and characteristics of adhesives  (vi) condition of uninsulated surfaces
	(vii) joint preparation required (d) Considerations and importance of minimizing material wastage during layout (e) Techniques and procedures for laying-out insulation for: (i) ducts
	(ii) pipes (iii) vessels (iv) equipment (v) walls, floors, ceilings (vi) other
	<ul> <li>(f) Importance of adhering to shop manuals and directives for layout</li> <li>(g) Types, purpose and use of tools and measuring devices for layout: <ul> <li>(i) measuring tapes and rules</li> <li>(ii) squares</li> <li>(iii) dividers</li> <li>(iv) scribers</li> <li>(v) protractors</li> </ul> </li> </ul>

	KNOWLEDGE
Laying-out shop work (cont d)	<ul> <li>(h) Importance of accuracy when laying—out</li> <li>(i) Mathematics: <ul> <li>(i) linear measurement for layout</li> <li>(ii) calculation of areas of surfaces:</li> <li>(a) plane</li> <li>(b) cylindrical</li> <li>(c) conical</li> <li>(d) spherical</li> <li>(e) warped</li> <li>(iii) construction of geometrical figure for layout</li> </ul> </li> </ul>
Laying-out field work	<ul> <li>(a) Interpretation of drawings and specificat to determine:</li> <li>(i) characteristics of surfaces to be insulated</li> <li>(ii) location</li> <li>(iii) size of surface</li> <li>(iv) type and quantity of insulation</li> <li>(v) field fabrication requirements</li> </ul>
	(b) Geometrical principles of laying-out surfaces:  (i) plane (ii) cylindrical (iii) conical (iv) spherical (v) warped
	(c) Techniques and procedures for laying-out insulation for: (i) ducts (ii) pipes (iii) vessels (iv) equipment (v) walls, floors, ceilings (vi) other
	(d) Conditions of work area and work require-
	ments on field layout  (e) Techniques of laying-out material for field fabrication and installation using:  (i) measuring tapes and rules  (ii) squares  (iii) dividers  (iv) scribers

BLOCK	3	0	Insulation	Preparation	UNIT	1:	Layout	Techniques
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FUNCTIONS	KNOWLEDGE				
2. Laying-out field work (cont *d)	<ul> <li>(g) Factors to be considered when laying-out: <ul> <li>(i) material protection</li> <li>(ii) accessibility</li> <li>(iii) material organization and quantitie</li> </ul> </li> <li>(h) Importance of co-ordinating work with other trades or operations</li> <li>(i) Mathematics: <ul> <li>(i) linear measurement for field layout</li> <li>(ii) calculation of areas of surfaces: <ul> <li>(a) plane</li> <li>(b) cylindrical</li> <li>(c) conical</li> <li>(d) spherical</li> <li>(e) warped</li> </ul> </li> </ul></li></ul>				

BLOCK	3:	Insulation	Preparation	UNIT	2	:Fabrication	Techn
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BLOCK	3: Insulation Preparation  FUNCTIONS	U	NIT 2: Fabrication Techniques .  KNOWLEDGE
	FUNCTIONS		KNOWLEDGE
	electing materials for abrication	(a)	Interpretation of drawings and specifications to determine:  (i) shop or field fabrication requirements  (ii) type and quantity of material
		(b)	<pre>(iii) environmental conditions Type, purpose and characteristics of insulating materials: (i) calcium silicates (ii) asbestos (iii) magnesia (iv) polystyrenes (v) polyurethane (vi) glass (foam - fibre)</pre>
		(c)	<pre>(vii) others Factors influencing the selection of insulation materials: (i) durability (ii) flexibility to conform to contours (iii) finish required (iv) environmental conditions (v) location</pre>
		(d)	Importance of ensuring provision of adequate vapour barrier under specific insulating conditions
		(e)	
		(f)	Type, purpose and characteristics of adhesives used in fabrication:  (i) asphaltic  (ii) polymeric  (iii) elastomeric
		(g)	Factors to be considered in the selection of adhesives for fabrication:  (i) type of insulation  (ii) compatibility with insulation material and surface to be insulated  (iii) speed of adherence

BLOCK	3	:	Insulation	Preparation	UNIT	2	:	Fabrication	Techniques	
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	FUNCTIONS		KNOWLEDGE
1.	Selecting materials for fabrication (cont'd)	(h)	Science:  (i) composition and properties of insulants  (ii) adhesives  (iii) solvents  (iv) quantity required for application  (v) ease of application to ensure complete coverage  (vi) strength of bond required
2.	Fabricating	(a) (b) (c) (d)	Interpretation of drawings and specifications to determine insulation requirements:  (i) type and size  (ii) location  (iii) shape  Factors to be considered in the utilization of field or shop fabrication:  (i) number of components  (ii) size  (iii) tool and equipment limitations  (iv) accuracy required  Limitation of materials for fabrication of complex shapes and sizes  Types, purpose and use of materials used for fabrication:  (i) calcium silicate  (ii) asbestos  (iii) polystyrene  (iv) polyurethane  (v) glass (foam and fibre)  Techniques of fabricating rigid and flexible insulation in shop or field by:  (i) cutting
		(f)	<pre>(ii) forming (iii) shearing (iv) drilling (v) routing (vi) rivetting Importance of adhering to shop manuals and manufacturers' directives during fabrication</pre>

#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

BLOCK 3 : Insulation Preparation UNIT 2 : Fabrication Techniques

FUNCTIONS	KNOWLEDGE
. Fabricating (cont'd)	<ul> <li>(g) Types, purpose and use of tools and equipment used for shop and field fabrication: <ul> <li>(i) knives</li> <li>(ii) saws (hand and power)</li> <li>(iii) chisels</li> <li>(iv) drills (power and hand)</li> <li>(v) files and rasps</li> <li>(vi) mitre table and box</li> <li>(vii) squares</li> <li>(viii) calipers</li> <li>(ix) tapes and rules</li> <li>(x) pliers</li> <li>(xi) rivetting</li> </ul> </li> <li>(h) Importance of care in handling material</li> </ul>

in shop or field
(1) Hazard of fabricating various insulants in confined spaces

ment use during fabrication

(m) Importance of observing safety regulations and utilization of personal safety equipment

(n) Care and storage of tools and equipment

(o) Mathematics:

(i) linear and angular measurement for fabrication

Consideration of material flow and equip-

tion of fabricated material and components

(j) Principles and method of constructing jigs and fixtures for quantity production
 (k) Importance of proper storage and protec-

(ii) calculation of volume and areas to determine material quantities

(p) Science:

- (i) characteristics and properties of insulation materials
- (ii) toxic effect of materials

BLOCK 3 : Insulation Pre	reparation UNIT	2 :	Fabrication	Techniques
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	FUNCTIONS		KNOWLEDGE
3.	Assembling	cations to (i) loc (ii) cha	tion of drawings and specifi- determine: ation of material or components tracteristics and complexity of face to be covered be, size and weight of material
		(iv) typ (b) Considerat assembly o (i) lim (ii) sha (iii) typ (iv) int con	e of adhesive or fastener ions of factors affecting the f materials before installation: itations of working space pe e of attachment erference of other equipment or struction
		(c) Types, pur terials an (i) adh (ii) ban (iii) nai (iv) sta (v) wir	ds ls, screws, skewers ples e
		ponents us:  (i) adh  (ii) ban  (iii) nai:  (iv) sta;  (v) wire	of assembling insulation coming: esives ds ls, screws, skewers ples e
		bly:     (i) brus     (ii) tros     (iii) scre     (iv) dril     (v) stas     (vi) plic     (vii) wren     (viii) band	pose and use of tools for assemshes and spray guns wels ewdrivers and hammers lls (power and hand) ple guns ers

BLOCK	3 :	Insulation	Preparation	UNIT	2	:	Fabrication	Techniques
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FUNCTIONS	KNOWLEDGE					
3. Assembling (cont'd)	<ul> <li>(f) Importance of care in the use of: <ul> <li>(i) adhesives</li> <li>(ii) spray guns</li> <li>(iii) stapling guns</li> </ul> </li> <li>(g) Adherence to manufacturers' directives in the mixing and/or application of adhesives</li> <li>(h) Procedures for mixing and/or applying adhesives</li> <li>(i) Importance of proper storage of assembled materials and components</li> <li>(j) Hazards relating to the flammability and toxic effects of adhesives</li> <li>(k) Importance of provision and use of fire extinguishers when applying or mixing adhesives</li> <li>(l) Care and storage of tools and equipment</li> <li>(m) Science: <ul> <li>(i) adhesives</li> <li>(ii) fire extinguishers and their uses</li> </ul> </li> </ul>					

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3:	Insulating	44

# INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

BLOCK 4	: Insulation Application	UNIT 1 :	Anchors and Attachments
-	and Installation		

FUNCTIONS	KNOWLEDGE
1. Installing Anchor	<ul> <li>(a) Interpretation of drawings and specifications to determine:</li> <li>(i) location</li> <li>(ii) type of anchor</li> <li>(iii) size and number of anchors</li> <li>(iv) method of securing anchors</li> </ul>
	(b) Factors to be considered in the selecti and application of anchors: (i) thickness of insulation (ii) density of material (iii) ambient conditions (iv) finish requirements
	(c) Type, purpose and size of anchors:     (i) welded pins     (ii) bonded pins     (iii) welded lugs     (iv) welded bolts     (v) welded nuts     (vi) wire mesh     (vii) pop-rivet pins     (viii) other
	(d) Type, purpose and use of temporary anch    (i) wire harness    (ii) wire cables    (iii) spring cables    (iv) expansion cables (spring and rub    (v) adhesives
	(e) Methods of locating and laying-out perm
	nent and temporary anchors  (f) Techniques of installing permanent anch using:  (i) adhesives  (ii) welding  (iii) rivetting  (iv) threaded fasteners  (v) other
	<ul> <li>(g) Methods of securing temporary anchors</li> <li>(h) Type, purpose and use of tools used in installation of permanent and/or temporanchors</li> </ul>
	(i) Importance of clean and dry surfaces in the installation of bonded and welded

(j) Provision of adequate ladders and scaffold

for installation of anchors

# INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

FUNCTIONS		KNOWLEDGE
. Installing Anchors (cont'd)	(k)	Importance of adhering to manufacturer's specifications in the application of adhesives
	(1)	Hazards in the use of welding equipment and adhesives
	(m)	Importance of provision and use of fire extinguishers when welding and/or applying adhesives
	(n) (o)	
		(i) linear measurement for laying out anchors
		(ii) calculation of areas to determine wire mesh requirements
		(iii) weights and measures to determine weight of insulation
	(p)	Science: (i) adhesives
		(ii) fire extinguishers and their uses
. Installing Anchoring Attachments	(a)	<pre>Interpretation of drawings and specifications to determine: (i) type of attachment (ii) location (iii) length and quantity of attachment (iv) methods of application</pre>
	(b)	Evaluation of conditions in the selection of attachments:  (i) type of insulation  (ii) type of finish  (iii) material weight  (iv) size of surface
	(c)	Type, purpose, size and characteristics attachments:  (i) spring washers  (ii) metal bands  (iii) self-tapping screws  (iv) metal and fibre washers  (v) staples  (vi) adhesives  (vii) wire  (viii) cotton and metal jackets  (ix) wire mesh  (x) twine

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	FUNCTIONS		KNOWLEDGE
2.	Installing Anchoring Attachments (cont'd)	(d)	Type, purpose and use of temporary attachments:  (i) expansion cable (spring and rubber)  (ii) adhesives  (iii) wire mesh  (iv) wire harness
		(e)	
		(f)	Type, purpose and use of tools or equip-
		(g)	ment for the installation of attachments Importance of suitable scaffolds and ladders to facilitate the installation of attachments
		(h)	Hazards in the use of welding equipment and adhesives
		(i)	Importance of provision and use of fire extinguishers when:  (i) welding  (ii) applying adhesives
		(j)	Mathematics:  (i) linear measurement to calculate location and length of attachments
		(k)	

BLC	OCK 4 : Insulation Application and Installation	UNIT 2 : Rigid and Flexible Insulation					
	FUNCTIONS	KNOWLEDGE					
1.	Evaluating installation requirements	(a)	Interpretation of drawings and specifications to determine:  (i) location of insulation  (ii) type, size and quantity of insulation				
		(b)					
		(c)	<ul><li>(i) electric power</li><li>(ii) water</li><li>(iii) lighting</li></ul>				
		(d)					
		(e)	materials during construction Importance of evaluating co-ordination of				
		(f)	work with other trades or operations				
			components				
		(g) (h)	<pre>with respect to: (i) quantity (ii) size and type (iii) location (iv) handling</pre>				
2.	Fitting insulation	(a)	<pre>Interpretation of drawings and specifica- tions to determine: (i) location of insulation (ii) type, size and quantity of materials (iii) purpose of insulation (iv) fitting requirements</pre>				
		(b)	Purpose and characteristics of insulating materials for:  (i) heat  (ii) frost  (iii) condensation  (iv) acoustics  (v) fireproofing  (vi) weatherproofing  (vii) other				

BLOCK	4	:	Insulation Application	UNIT	2	:	Rigid a	nd	Flexible	Insulation
			and Installation							

	FUNCTIONS	KNOWLEDGE
2.	Fitting insulation (cont'd)	<ul> <li>(c) Consideration of material characteristics when fitting: <ul> <li>(i) fragility</li> <li>(ii) flexibility</li> <li>(iii) size and weight</li> <li>(iv) type and density</li> <li>(v) ease of cutting and fitting</li> </ul> </li> <li>(d) Techniques of fitting insulation to: <ul> <li>(i) plane surfaces</li> </ul> </li> </ul>
		<ul><li>(ii) cylindrical and conical surfaces</li><li>(iii) spherical surfaces</li></ul>
		<pre>(iv) warped surfaces (e) Types, purpose and use of tools for fit- ting insulation:    (i) knives</pre>
		<pre>(ii) saws (hand and power) (iii) pliers (iv) scissors (v) rules and calipers</pre>
		<ul><li>(vi) miter boxes and tables</li><li>(f) Importance of care when handling and fit</li></ul>
		ting insulation (g) Importance of avoiding damage to vapour barriers when fitting and handling
		materials (h) Consideration of finish requirements when fitting
		<ul> <li>(i) Procedures for the selection and utilization of:</li> <li>(i) ladders</li> <li>(ii) scaffolds</li> </ul>
		<ul><li>(iii) lifting tackle and equipment</li><li>(j) Consideration of utilization of materials</li></ul>
		during fitting to avoid wastage (k) Importance of cleanliness and tidiness at
		work site (1) Hazards relating to the use of: (i) ladders and scaffolds (ii) lifting tookle and assignment
		<ul><li>(ii) lifting tackle and equipment</li><li>(m) Importance of utilization of personal safety equipment</li></ul>

BLOCK 4	:	Insulation Application and Installation	UNIT	2	Rigi	d and	Flexible	Insulation
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	and Installation		
	FUNCTIONS		KNOWLEDGE
2.	Fitting insulation (cont'd)	(n)	Mathematics:  (i) linear and angular measurement for fitting  (ii) calculation of areas and volume to determine insulation requirements  (iii) weights and measures to calculate weight of insulation  (iv) conversion of temperature scales
		(0)	from Fahrenheit to Centigrade  Science:  (i) heat transfer (a) conduction (b) convection (c) radiation  (ii) thermal expansion and contraction  (iii) sources of heat (iv) acoustics (v) transmission of sound (vi) composition and properties of insulation  (vii) mechanical advantage of simple machines (viii) pulley blocks (ix) temperature indicators and scales
3.	Applying and securing insulation	(a) (b)	Interpretation of drawings and specifications to include:  (i) location of insulation  (ii) methods of application  (iii) methods of securing insulation  (iv) type of finish  Consideration of material characteristics  when applying and securing insulation:  (i) size and weight of material  (ii) type and density of insulation  (iii) position and location of insulation  (iv) type and location of anchors and/or attachments  Effects of surface characteristics and temperatures in applying and securing of insulation

#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

BLOCK	4	Insulation Application
		and Installation

UNIT 2. Rigid and Flexible Insulation

#### FUNCTIONS

#### KNOWLEDGE

- 3. Applying and securing insulation (cont'd)
- Type, purpose and methods of applying insulation:
  - (i) bonded
  - (ii) wrapped
  - (iii) mechanically attached
  - (iv) trowelled
  - (v) sprayed
- Type, purpose and techniques of securing insulation using:
  - (i) wire
  - (ii) staple
  - (iii) screws and washers
  - (iv) adhesives
  - (v) welded pins and clips

  - (vi) metal bands
    (vii) fabric jackets
  - (viii) tape
  - (ix) others
- Type, characteristics and location of anchors and/or attachments for the application and securing of insulation
- Importance of applying and securing insulation to clean, dry surfaces
- (h) Type, purpose and use of tools in the application and securing of insulation:
  - (i) brushes and spray guns
  - pliers (ii)
  - (iii) metal banding tools
  - metal shears hand and portable (iv)
  - $(\nabla)$ scissors
  - needle and thread (vi)
  - (vii) wire mesh tighteners
  - (viii) trowels
- Consideration of requirements for provision of air space between extremely hot surfaces and insulation
- Techniques for provision of air space between insulated surfaces using:
  - (i) metal lath and spacers
  - (ii) welded channels
  - (iii) high rib lath
  - (iv) insulation blocks

	FUNCTIONS		KNOWLEDGE
3.	Applying and securing insulation(cont'd)	(k)	Methods of applying and techniques of tro- welling insulation cements to hot surface
	THE ALEGICAL (COMP. C)	(1)	
		(m)	
		(n)	· · ·
		(0)	
		(p)	
		(q)	
		(r)	
		(s) (t)	Methods of erecting ladders and scaffolds Care, storage and handling of tools durin installation
		(u)	Mathematics:  (i) linear and angular measurement to determine insulation quantities  (ii) calculation of area and volume to determine material quantity
			(iii) weights and measures to determine weight of insulation to be secured
		(v)	Science:  (i) adhesives (ii) threaded fasteners (iii) welding by fusion (iv) heat transfer:  (a) convection (b) radiation (c) conduction

	FUNCTIONS		KNOWLEDGE
1.	Evaluating requirements for the mixing and application of insulating cements and compounds	(a)	tions to determine:  (i) location  (ii) type, purpose and thickness of application
		(b)	storage for insulating cements and com-
		(c)	pounds Investigation of suitability of available services for the mixing and application of cements and compounds:  (i) water  (ii) electrical power  (iii) heat
		(d)	Evaluation of ladders, scaffolds and hois-
		(e)	33 3
		(f)	required for a specific use Assessment and selection of tools and equipment required for mixing and applying insulating cements and compounds.
		(g)	
2.	Mixing insulating cements and compounds	(a)	<pre>Interpretation of drawings and specifica- tions to determine: (i) type of cements and/or compounds (ii) thickness and number of coats in application</pre>
			(iii) quantity of material (iv) mix requirements
		(b)	Purpose and application requirements of

insulating cements and compounds:

(i) primary insulant(ii) rough base for finish

# INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

BLOCK 4 : Insulation Application and Installation		Ţ	UNIT 3 : Insulating Cements and Compounds
	FUNCTIONS		KNOWLEDGE
2.	Mixing insulating cements and compounds (cont'd)	(c)	Type, characteristics and use of insulating cements and compounds:  (i) asbestos  (ii) magnesia  (iii) mineral wool  (iv) vermiculite  (v) granulated cork  (vi) plastic cements  (vii) asphaltic compounds  (viii) others
		(d)	Type, purpose and use of additives used in mixing insulating cements and compounds:  (i) sand  (ii) Portland cement  (iii) latex
		(e)	(iv) others Consideration of the insulating qualities of mixed insulants for specific applications
		(f)	Type, purpose and use of tools and equipment used in mixing:  (i) mixing boxes  (ii) hoes - shovels - rakes  (iii) containers - pails and barrels  (iv) rubber gloves  (v) wheel barrows
		(g)	Procedures for measuring and calculating
		(h) (i)	proportion of dry-mix aggregates Methods of combining and mixing aggregates Correct proportions of water to obtain proper mix consistency for:  (i) primary insulation
		(.)	(ii) rough base for finish
		(j) (k)	Effects of freezing on mixed aggregates Results of over-estimating mixed requirements
		(1)	Care, cleaning and storage of tools and
		(m)	equipment after use  Mathematics:  (i) linear measurement to determine area to be covered  (ii) calculation of volume to determine quantity of mixed ingredients  (iii) ratio and proportion to determine
			mir manager and

mix proportions

BLOCK 4 : Insulation Application and Installation		UNIT 3 : Insulating Cements and Compounds					
	FUNCTIONS		KNOWLEDGE				
2.	Mixing insulating cements and compounds (cont'd)	(n)	Science:  (i) composition and properties of:  (a) granular insulants  (b) cement  (c) sand  (ii) purification of water  (iii) density and specific gravity				
3.	Applying insulating cements and compounds	(a) (b) (c) (d)	Interpretation of drawings and specifications to determine:  (i) location and environmental conditions  (ii) type of insulant required  (iii) thickness and method of application  Requirements, provision and/or erection of ladders, scaffolds and lifting tackle for applying insulating cements and compounds  Importance of checking security and attachment of reinforcement and grounds before application  Type, purpose and use of tools and equipment required for applying insulating cements and compounds:  (i) pails  (ii) trowels  (iii) spray guns  (iv) brushes  (v) rubber gloves				
		(e) (f) (g)	<pre>(vi) straight edges Techniques of applying insulating cements and compounds to: (i) plane surfaces (ii) cylindrical surfaces (iii) conical surfaces (iv) spherical surfaces (v) warped surfaces Considerations in using secondary reinforcing materials in multi-coat applications Type, purpose and methods of application of secondary reinforcement materials: (i) fabrics (ii) wire mesh (iii) metal lath</pre>				

#### INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

BLOCK 4 : Insulation Application and Installation		UNIT 3. : Insulating Cements and Compounds				
	FUNCTIONS	KNOWLEDGE				
3.	Applying insulating cements and compounds (cont'd)	<ul> <li>(h) Methods and importance of protecting equiment and property from possible damage during application</li> <li>(i) Importance of cleanliness and good house-keeping at work site</li> <li>(j) Hazards in the improper use of ladders, scaffolds and lifting tackle</li> <li>(k) Procedure for protecting application untidry from damage and inclement weather or environmental conditions</li> <li>(l) Care, cleaning and storage of tools and equipment after use</li> <li>(m) Mathematics: <ul> <li>(i) linear measurement to determine</li> </ul> </li> </ul>				

(n) Science:

thickness and area of surface to be

covered

(i) pulleys and pulley blocks(ii) humidity and its measurement

(iii) temperature indicators and scales

# AN ANALYSIS OF INDUSTRIAL INSULATION APPLICATION AND INSTALLATION

# BLOCK 5: Finishing Techniques TABLE OF CONTENTS UNIT 1: Fabrics page 49 2: Asbestos 52 3: Mastic 55 4: Metal 58

FUNCTIONS		KNOWLEDGE		
l. Selecting of fabr finishing	rics for (a)	specifications to determine:  (i) type and grade of fabric  (ii) method of attachment  (iii) characteristics of surface to be covered  (iv) location		
	(b)	of fabrics used for finishing: (i) cotton (ii) glass (iii) asbestos		
	(c)	(iv) other Techniques for the identification of type		
	(d)	and grade of fabrics Factors to be considered in the selectio		
	(~,)	of fabrics:  (i) environmental conditions  (ii) exposure to damage or wear  (iii) type and grade  (iv) strength, durability and appearance		
		<pre>(v) flexibility (vi) characteristics of shape of     surface to be covered</pre>		
		(vii) type of attachment		
	(e)	fabric to minimize waste		
	(f) (g)	Consideration of allowances for seams Consideration of method of attaching and fastening in the selection of fabric (i) adhering (ii) sewing (iii) stapling		
	(h)	(iv) taping (v) others Science: (i) composition and properties of materials		

F	UNCTIONS		KNOWLEDGE			
. Applyir	ng fab <b>ric finishes</b>	(a)	Techniques of applying fabrics by: (i) cutting (ii) sewing (iii) tearing (iv) trowelling			
		(b)	Types, purpose and use of tools for the application of fabrics:  (i) rules and tapes  (ii) brushes  (iii) scissors  (iv) needles  (v) shears  (vi) knives			
		(c)	<pre>(vii) trowels Techniques for attaching and securing fabrics: (i) adhering (ii) sewing (iii) stapling (iv) taping (v) others</pre>			
		(d)				
		(e)	Techniques for preparing fabrics prior			
		(f)	to attachment Effects of shrinkage of materials during			
		(g)	and after application Importance of correct sewing techniques			
		(h)	<ul><li>(i) plane surfaces</li><li>(ii) cylindrical surfaces</li><li>(iii) angular surfaces</li><li>(iv) spherical surfaces</li></ul>			
		(i)	<ul> <li>(v) warped surfaces</li> <li>Considerations in the selection and use of adhesives to be used with:</li> <li>(i) cotton</li> <li>(ii) glass</li> <li>(iii) asbestos</li> </ul>			
		(j)				

BLO	BLOCK 5 : Finishing Techniques UNIT 1 : Fabrics						
	FUNCTIONS		KNOWLEDGE				
2.	Applying fabric finishes (cont'd)	(k) (l) (m) (n) (o) (p) (q) (r)	Methods and importance of protecting equipment and property from possible damage during application of adhesives Adherence to relevant manuals and directives in the application of adhesives Methods of preparing surfaces prior to application of fabric finishes for:  (i) durability (ii) appearance (iii) fire-proofing qualities Hethods of avoiding waste in the application of fabrics and adhesives Hethods and importance of providing adequate lapping of fabrics during application to:  (i) avoid separation (ii) add strength (iii) provide sufficient material for seams Hazards relating to the toxic effects of chemically-based adhesives Care and storage of tools and equipment Mathematics:  (i) linear measurement to determine material quantities (ii) measurement of area to calculate surfaces to be covered				
		(s)	<pre>(iii) geometry for layout Science: (i) adhesives (ii) solvents (iii) fireproofing qualities of     materials (iv) fire extinguishers and their     uses</pre>				

BLOCK 5 : Finishing Techniques	UNIT 2 : Asbestos Cement Finishes			
FUNCTIONS	KNOWLEDGE			
1. Selecting asbestos cements for finishing	<ul> <li>(a) Interpretation of drawings and specifications to determine: <ul> <li>(i) type of cement or compound</li> <li>(ii) method of application</li> <li>(iii) characteristics of surface to be finished</li> <li>(iv) location</li> <li>(v) quantity of material required</li> </ul> </li> <li>(b) Type, grade and characteristics of asbestos finishing cements</li> <li>(c) Identification of types and grades of asbestos cements</li> <li>(d) Factors to be considered in the selection of asbestos cements for finishing: <ul> <li>(i) grade</li> <li>(ii) finish appearance</li> <li>(iii) environmental conditions</li> <li>(iv) exposure to damage</li> </ul> </li> <li>(e) Considerations of type and use of attachments for asbestos cement finish application</li> <li>(f) Science: <ul> <li>(i) physical properties of asbestos</li> </ul> </li> </ul>			
2. Mixing asbestos cement finishes	<ul> <li>(a) Type, purpose and characteristics of asbestos cement finishes for: <ul> <li>(i) base coats</li> <li>(ii) finish coats</li> </ul> </li> <li>(b) Type, purpose and characteristics of additives used for asbestos cement finishes: <ul> <li>(i) Portland cement</li> <li>(ii) Medusa cement</li> <li>(iii) plaster of Paris</li> <li>(iv) other</li> </ul> </li> <li>(c) Characteristics and mix ratios of ingredients used in preparing asbestos cement finishes</li> </ul>			

BLOCK 5 : Finishing Techniques	UNIT 2	2:	Asbestos	Cement	Finishes
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FUNCTIONS	KNOWLEDGE
2. Mixing asbestos cement finishes (cont'd)	(d) Evaluation of services required when mixing asbestos cement finishes:  (i) water  (ii) heat  (iii) electric power and lighting
	(e) Techniques of measuring and consolidating dry mix ingredients
	<ul><li>(f) Procedures for wet mixing ingredients</li><li>(g) Nature and characteristics of water</li></ul>
	supply used for wet mixing (h) Importance of correct consistency of wet mix ingredients
	(i) Type, function and use of tools and equipment used for mixing: (i) boxes (ii) pails and barrels (iii) rakes, hoes, shovels (iv) électrically and mechanically operated mixers
	(j) Importance of evaluating batch mix requirement and its utilization for specific applications to eliminate
	material wastage (k) Health hazards relating to the mixing
	of asbestos cement finishes (1) Importance of using personal protective equipment and clothing when mixing
	(m) Importance of cleanliness and tidiness at mixing site
	(n) Care, cleaning and storage of tools and equipment
	(o) Mathematics:  (i) calculation of volume to determine mix requirements  (ii) calculation of time and speed of application in material utilization  (iii) ratio and proportion to determine dry mix aggregates
	(p) Science:  (i) composition and properties of materials  (ii) water purification

BLOCK 5 : Finishing Techniques	UNIT 2 : Asbestos Cement Finishes
FUNCTIONS	KNOWLEDGE
3. Applying asbestos cement finishes	(a) Interpretation of drawings and specifications to determine: (i) location and height (ii) shape and surface characteristics to be covered (iii) finish appearance (iv) thickness (b) Evaluation of ladders, scaffolds and lifting tackle requirements for application (c) Techniques for applying asbestos cement finishes: (i) hand trowelled (ii) mechanically sprayed and hand compacted (d) Type, function and use of tools and equipment used for application: (i) trowels (ii) floats (iii) straight edges (iv) hawks - boards - pails (v) spraying equipment (vi) special hand-made trowelling devices (vii) other (e) Consideration of number of coat applications on finish appearance (f) Methods and importance of providing a textured surface to primary finish coat for application of final finish (g) Effect of over application and incorrect aggregate proportion on final finish
	appearance (h) Hazards relating to the use of ladders, scaffolds and lifting tackle
	<ul><li>(i) Importance of using suitable personal safety equipment during application</li><li>(j) Care, cleaning and storage of tools and equipment</li></ul>

BLOCK 5 : Finishing Techniques		NIT 3: Mastic Finishes
FUNCTIONS		KNOWLEDGE
1. Selecting mastic finishes	(a)	Interpretation of drawings and specifications to determine:  (i) type of mastic required  (ii) method of application  (iii) characteristics of surface to be finished  (iv) location
	(b)	Type, purpose and characteristics of mastic finishes:  (i) asphaltic  (a) water-base emulsions  (b) chemically-based emulsions
	(c)	
	(d)	
	(e)	Evaluation of temperature and atmospheric condition on the application and selection of mastic finishes
	(f)	Type, purpose and characteristics of surfaces compatible with mastic finish application
	(g)	Type, function, characteristics and selection of membranes used with mastic finish application
	(h)	Science:
		(i) composition and properties of materials - asphaltic polymeric compounds
		(ii) heat (a) convection
		(b) radiation (iii) atmospheric corrosion
2. Applying mastic finishes	(a)	Interpretation of drawings and specifications to determine:  (i) location and height  (ii) shape and surface characteristics  (iii) finish appearance

BLOCK 5 :	Finishing	Techniques	UNIT	3		Mastic Finishes
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BLOCK 5: Finishing Techniques			NIT 3 : Mastic Finishes		
	FUNCTIONS		KNOWLEDGE		
2.	Applying mastic finishes (cont'd)	(b)	lifting tackle requirements for		
		(c)	application Techniques for applying mastic finishes		
		(0)	using:		
			(i) brushes		
			(ii) trowels (iii) spray		
			(iv) glove		
		(d)	Type, purpose, use and/or operation of tools and equipment:		
			(i) brushes		
			(ii) trowels		
			<pre>(iii) rubber gloves (iv) portable power-operated spraying</pre>		
			equipment		
		(e)			
		(f)	equipment Factors affecting number of coats in		
			application		
		(g)			
		(h)	dried or cured insulated surfaces Procedures for installing membrane during		
			application		
		(i)	Fire hazards relating to application of mastic compounds		
		(j)			
		(1)	protection during application		
		(k)	Toxic effects of chemically based mastics and solvents		
		(1)	Type, purpose and use of solvent required		
		(m)	for specific types of mastics Importance of cleanliness and tidiness		
		(111)	at work site		
		(n)	Methods of protecting adjacent areas and		
		(0)	equipment during application of mastics Care, cleaning and storage of tools		
		(0)	and equipment		

BLOCK 5: Finishing Techniques	UNIT 3: Mastic Finishes
FUNCTIONS	KNOWLEDGE
2. Applying mastic finishes (cont'd)	<ul> <li>(p) Mathematics:         <ul> <li>(i) calculation of surface area to determine material requirements</li> <li>(ii) calculation of time and speed of application</li> </ul> </li> <li>(q) Science:         <ul> <li>(i) fire extinguishers and their uses</li> <li>(ii) organic solvents</li> </ul> </li> </ul>

	FUNCTIONS		KNOWLEDGE
1.	Selecting of metals for finishing	(a)	Interpretation of drawings and specifications to determine:  (i) type of metal finish  (ii) method of attachment  (iii) location  (iv) surface characteristics to be covered
		(b)	
		(c)	
		(d)	sheet metal Factors to be considered in the selection and application of metal finishes:  (i) environmental conditions  (ii) strength, durability and appearance  (iii) characteristics and shape of surface to be covered
		( )	(iv) co-efficient of expansion
		(e)	Evaluation of manufactured dimensions to minimize wastage
		(f)	
		(g)	
			(ii) atmospheric corrosion (iii) galvanic corrosion
2.	Laying out, cutting and preforming metal finishes	(a)	Interpretation of drawings and specifications to determine:  (i) shape of surface to be covered (ii) material type and thickness (iii) method of attachment (iv) location

BLOCK 5 : Finishing Technique	ues UNIT 4 : Metal
FUNCTIONS	KNOWLEDGE
2. Laying out, cutting and preforming metal finishes (cont'd)	(b) Techniques for laying out geometric shapes of metal finishes for:  (i) pipes  (ii) ducts  (iii) vessels
	(iv) equipment  (c) Importance of allowing for adequate overlapping of metal finishes during layout for:  (i) water-proofing  (ii) appearance  (iii) expansion and contraction
	(iv) strength of joint or seam (d) Considerations of locating seams on
	shortest dimensions in geometric layout
	(e) Type, purpose and use of tools used in metal layout:  (i) rules and tapes  (ii) squares and protractors  (iii) scribers  (iv) dividers and calipers
	<ul> <li>(f) Techniques of cutting and shearing metals</li> <li>(g) Type, purpose and use of tools and equipment used in cutting and shearing metals:</li> <li>(i) metal shears</li> <li>(a) hand</li> <li>(b) foot-operated</li> </ul>
	(c) power-operated (ii) scissors (iii) knives (iv) metal cutting saws (hand and power operated)
	<ul><li>(h) Evaluation of shape of insulated surfaces to determine:</li><li>(i) necessity for preforming</li></ul>
	<ul> <li>(ii) allowances for installation</li> <li>(i) Techniques of forming, rolling and bending, using: <ul> <li>(i) metal breaks</li> <li>(ii) metal rollers</li> <li>(iii) forming pliers</li> </ul> </li> </ul>

BLOCK	5		Finishing	Techniques	UNIT	4	:	Metal
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	FUNCTIONS		KNOWLEDGE
2.	Laying out, cutting and preforming metal finishes	(j)	Effects and methods of allowing for
	preforming metal finishes (cont'd)		dimensional changes when rolling, forming and bending
		(k)	
		(1)	
		(m)	
		(n) (o)	
			<pre>(vi) stresses - tensile - compressive -</pre>

BLOCK 5 : Finishing Technique	es UNIT 4: Metal	
FUNCTIONS	KNOWLEDGE	
3. Applying metal finishes	<ul> <li>(a) Interpretation of drawings and specifications to determine characistics of surface to be covered:</li> <li>(i) location</li> <li>(ii) method of attaching finish</li> <li>(iii) type of finish required</li> </ul>	ter-
	(b) Evaluation of and methods of erect ladders, scaffolds and lifting tag	kle
	for the application of metal finis (c) Evaluation of extent of job to determine organization and sequence operation	
	(d) Techniques of applying and or atta metal finishes using:  (i) bands  (ii) threaded fasteners  (iii) rivets  (iv) adhesives  (v) mechanical locks (metal sea (vi) combined attachments	
	<pre>(vii) others (e) Types, purpose and use of tools re for the application of metal faste (i) banding tools (ii) drills (hand and power) (iii) screwdrivers (iv) shears (v) pliers (vi) wrenches (vii) rivetting guns and snaps</pre>	
	<ul><li>(viii) brushes</li><li>(f) Techniques of cutting and fitting</li></ul>	during
	application  (g) Techniques of handling, lifting and temporarily holding metal finishes  (i) wire  (ii) flexible bands (rubber and to (iii) hangers and 'S' clips	d using:
	<ul><li>(iv) others</li><li>(h) Consideration of spacing and locat of anchors and/or attachments for specific application</li></ul>	ion

-	FUNCTIONS		KNOWLEDGE
3.	Applying metal finishes (cont'd)	(i) (j) (k) (l) (m) (n) (o) (p)	applying of metal finishes:  (i) contact with electrical circuitry and equipment  (ii) physical injury  (iii) damage to insulants and adjacent equipment and/or property  Importance of avoiding misuse of ladders, scaffolds and lifting tackle  Effects of and importance of avoiding use of dissimilar metals when installing metal finishes  Procedures for caulking and sealing joints to prevent the ingress of moisture and other contaminants  Considerations and techniques for joint concealment for appearance  Hazards of untidy workshop or work site





